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HAWAII AGRICULTURAL EXPERIMENT STATION.

J. G. SMITH, SPECIAL AGENT IN CHARGE.

BULLETIN No. 8.



METHODS OF MILKING.

BY

F. G. KRAUSS,

INSTRUCTOR IN AGRICULTURE, KAMEHAMEHA BOYS SCHOOL,
HONOLULU.

Under the supervision of
OFFICE OF EXPERIMENT STATIONS,
U. S. Department of Agriculture.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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HAWAII AGRICULTURAL EXPERIMENT STATION, HONOLULU.

[Under the supervision of A. C. TRUE, Director of the Office of Experiment Stations,
United States Department of Agriculture.]

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LETTER OF TRANSMITTAL

HONOLULU, HAWAII, *January 27, 1905.*

SIR: I have the honor to transmit herewith, and recommend for publication as Bulletin No. 8 of this station, a paper on Methods of Milking, embodying the results and conclusions from a thirty days' trial of the "Hegelund" or Danish method of milking as conducted at the Kamehameha Boys School dairy, July 1 to 30, 1904, prepared by Mr. F. G. Krauss, instructor in agriculture at the school.

This is an important investigation, showing how a direct and large financial gain may be made at the cost of only a little personal supervision on the part of those owning the dairy herds that supply Honolulu, the consumer at the same time being furnished milk of a better quality.

Respectfully,

JARED G. SMITH,
Special Agent in Charge.

Recommended for publication.

A. C. TRUE, *Director.*

Publication authorized.

JAMES WILSON,
Secretary of Agriculture.

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METHODS OF MILKING.

INTRODUCTION.

The matter of milking is not the least important of dairy operations, yet the fact remains that no part of the dairy work has hitherto received less careful and systematic investigation. In perhaps no other way can we account for the slovenly and ignorant manner in which much of the milking is usually done on the farm and even in large and otherwise well-managed dairies, where there is always difficulty in securing conscientious and skilled milkers. This is especially true in Hawaii, where the poorly trained Asiatic is so largely intrusted with the responsible care of the dairy cow.

It matters not how high the grade of the individuals comprising the dairy herd, or with what care they are housed and fed, careless or ignorant milking is sure to reduce the quantity and lower the quality of the milk and eventually ruin the milking qualities permanently, especially in the case of the heaviest milkers. It is even claimed by high authorities that the progeny of a fine milking strain may be seriously affected in their milking qualities for generations afterwards, no amount of after care being capable of repairing the damage done. This indicates strikingly one phase of the possible far-reaching effect of carelessness or ignorance in one branch of the manifold operations of the dairy.

On the other hand, careful, observant dairymen have profited by the knowledge that thorough "stripping" tends to stimulate and develop milk secretion, and therefore insist that their milkers "strip" clean. The strippings are much richer in fat than is the first milk drawn from the udder.

With this knowledge so general among dairymen, it seems a little strange that the facts have only recently been worked over into a definite practical system, applicable in every well-regulated dairy.

The investigations here recorded are, with slight modifications, based upon the system of udder manipulation as worked out and advocated by the Danish veterinarian, Dr. J. Hegelund, of the Ladelund Dairy School, Denmark.

PLAN OF THE EXPERIMENT.

The experiment here reported was similar in plan to those described by Prof. F. W. Woll in a bulletin of the Wisconsin Experiment Station on the same subject.^a

^a Wisconsin Sta. Bul. 96.

On July 1, 1904, after ten days' preliminary study and practice two cows of the Kamehameha School dairy herd were selected for our experiment. These may be described as follows:

Cow No. 4.—Grade Holstein, 5 years old; second calf; in milk two hundred and twenty days; due to calve in December, 1904. Yield of milk for ten days previous to experiment 78 quarts, or a daily average of 7.8 quarts. Average per cent of butter fat for ten days previous to experiment 4, equivalent to 6.7 pounds for the ten days.

Cow No. 12.—Grade Shorthorn, 7 years old; fourth calf; in milk ninety days; due to calve in February, 1905. Yield of milk for ten days previous to the experiment 101½ quarts, a daily average of 10.15 quarts. Average per cent fat for ten days previous to experiment 3.5, equivalent to 7.63 pounds for the ten days.

These two cows represented average conditions of the school herd, and are probably a good deal better than those existing generally in the Hawaiian dairies. Both cows were in good milking condition, everything considered. Each received our general feeding ration, which consists of approximately 36 pounds green fodder (*Panicum molle* and sorghum in equal proportions) chopped and mixed with 3 pounds wheat middlings, 4 pounds bran, and 1 pound oil cake, as a daily ration, divided into a morning and an evening meal, fed during milking time, which is at 5 a. m. and 4 p. m. The cows have free range of maineine (Bermuda grass) pasture, which was very dry and scant at this season.

Cow No. 4 was regularly milked by the author throughout the thirty-day test period, and after milked by his student assistant, an experienced and unusually conscientious milker. Cow No. 12 was milked regularly by the assistant, and after milked by the author. This system of cross milking resulted in the desired thoroughness. Each of us milked as clean as possible at the regular milking, and again at the after milking, with the idea, partly at least, of each out-doing the other.

Particular stress should be laid on this phase of the experiment, since it is plain to every experienced milker that a much larger percentage of milk would have been obtained in the after milking had the regular milking been less thoroughly done, as doubtless would be the case under ordinary conditions. Our aim, however, was to ascertain the least amount of milk obtainable by aid of the Hegelund method. Doubtless this will also in large part explain the more striking results obtained by other investigators working along the same line.

Before taking up the record of our milking it might be well to state here that in no case did more than two minutes elapse between the regular milking and the after milking, the manipulations and strip-pings requiring on an average two and one-half minutes. Immedi-

ately after each milking the milk was measured and samples were taken for the fat test by the Babcock method.

RESULTS OF THE EXPERIMENT.

The following table gives the detailed thirty days' milk-yield record, which has been divided into three periods of ten days each:

Detailed record of milk yields covering thirty days' trial of the Hegelund or Danish method of milking at Kamehameha School dairy, July 1-30, 1904.

PERIOD I, JULY 1-10, INCLUSIVE.

Date.	Cow No. 4—Grade Holstein, 5 years old, second calf, third quarter of lactation period.				Cow No. 12—Grade Shorthorn, 7 years old, fourth calf, first quarter of lactation period.			
	Regular milking.	Fat.	After milking.	Fat.	Regular milking.	Fat.	After milking.	Fat.
1904.	<i>Quarts.</i>	<i>Per ct.</i>	<i>Ounces.</i>	<i>Per ct.</i>	<i>Quarts.</i>	<i>Per ct.</i>	<i>Ounces.</i>	<i>Per ct.</i>
July 1.....	4	3.4	6	9.2	5	3.5	2½	6.3
	3½	4.0	7	8.8	4	4.0	4½	6.0
July 2.....	4½	4.4	3½	9.1	5½	3.2	4½	5.6
	3½	4.5	4	8.0	4	4.0	6½	6.1
July 3.....	4½	3.4	5	9.0	5½	3.3	4½	6.6
	2¾	4.2	2	8.2	4½	3.2	3	6.0
July 4.....	5	4.8	3½	10.0	5½	3.8	4	5.8
	2¾	3.5	a 16	6.2	4	b 3.0	4	5.8
July 5.....	5	5.0	6	11.1	5½	3.2	4	7.4
	3	4.0	7	7.2	4	3.0	6	6.2
July 6.....	4¾	4.4	9	10.0	5½	3.6	6	7.6
	2¾	4.0	4	8.1	4½	4.0	3	8.4
July 7.....	5½	4.8	5	12.0	5½	4.0	5	6.8
	2¾	5.0	3½	7.0	4½	4.0	4	7.2
July 8.....	5½	5.0	4½	b 12.0	6	3.8	4½	8.4
	2½	4.2	3	7.8	4½	4.0	4	8.0
July 9.....	5¾	4.0	5	12.0	6	4.0	6	9.0
	2	3.4	a 24	6.0	5	4.0	4	7.8
July 10.....	5	3.5	3½	9.0	6½	3.0	5	10.0
	2½	3.7	5	5.4	4½	2.6	3	8.4
Total milk.....	76¾	.....	126½	.....	99½	.....	88	.....
Daily averages.....	7.67	4.16	12.65	8.8	9.95	3.56	8.8	7.17

PERIOD II, JULY 11-20, INCLUSIVE.

1904.								
July 11.....	5	4.0	2½	8.0	6	3.6	4½	8.4
	2½	4.4	2	7.4	4	3.1	4½	8.8
July 12.....	5	5.4	3	8.2	6½	4.0	4	9.0
	2¾	3.8	7	7.0	4½	3.8	8	7.8
July 13.....	5	5.0	3½	9.0	6	4.0	5½	8.4
	3	5.0	8	7.2	5	3.4	5	7.8
July 14.....	4¾	3.8	3½	8.0	6	3.8	4	8.6
	3½	5.0	8½	6.8	5	3.6	4½	9.8
July 15.....	4¾	4.5	4	8.6	5½	3.4	6½	9.6
	3½	4.2	4½	7.2	4½	3.5	4½	8.0
July 16.....	4½	4.0	4	8.2	6	3.0	6½	7.0
	3	4.2	8	7.4	5	4.0	5	8.4
July 17.....	4	3.2	4½	7.6	5½	2.8	5½	7.2
	3	5.0	4	6.8	5	4.4	7½	9.4
July 18.....	4½	5.6	5	9.8	6	3.2	5	7.8
	2½	4.8	3	7.4	4½	3.6	3½	7.4
July 19.....	4½	5.0	4	12.0	5½	3.2	4½	7.1
	2¾	3.6	2½	9.1	5	3.1	2½	9.8
July 20.....	4½	4.6	6	8.8	5½	4.0	4	8.0
	3½	4.8	6	7.4	4½	3.5	2½	7.8
Total milk.....	76	.....	93½	.....	106½	.....	100½	.....
Daily average.....	7.6	4.49	9.35	8.09	10.67	3.50	10.50	8.30

a Cow No. 4 habitually held her milk back during evening milking. On the evenings of the 4th and 9th all the withheld milk was brought down by manipulation.

b Assumed; sample lost.

Detailed record of milk yields covering thirty days' trial of the Hegelund or Danish method of milking at Kamehameha School dairy, July 1-30, 1904—Continued.

PERIOD III, JULY 21-30, INCLUSIVE.

Date.	Cow No. 4—Grade Holstein, 5 years old, second calf, third quarter of lactation period.				Cow No. 12—Grade Shorthorn, 7 years old, fourth calf, first quarter of lactation period.			
	Regular milking.	Fat.	After milking.	Fat.	Regular milking.	Fat.	After milking.	Fat.
1904.	<i>Quarts.</i>	<i>Per ct.</i>	<i>Ounces.</i>	<i>Per ct.</i>	<i>Quarts.</i>	<i>Per ct.</i>	<i>Ounces.</i>	<i>Per ct.</i>
July 21	4	4.8	3½	8.6	5½	3.2	3	8.0
July 22	2¾	3.4	4	7.8	4½	3.1	3	8.0
July 23	4¾	5.2	5	10.3	6½	4.0	6	7.6
July 24	3½	4.8	4½	8.1	4½	3.5	4	7.2
July 25	4½	4.0	4½	8.6	6	4.0	4	9.0
July 26 ^a	3	4.0	5	8.0	3¾	3.6	4½	7.4
July 27	4½	3.8	4	9.2	6½	4.0	4½	9.0
July 28	2¾	4.8	6½	9.0	4½	3.6	2½	7.2
July 29	4½	4.2	4	9.3	5½	4.0	3½	8.4
July 30	1½	3.4	4½	9.1	4½	3.8	2½	8.2
July 26 ^a	5¾	.....	4	.....	6½	.....	2½	.....
July 27	1¼	.....	3	.....	3½	.....	2½	.....
July 28	4	.....	3	.....	6½	.....	5	.....
July 29	2½	.....	2½	.....	4	.....	4½	.....
July 30	5¾	.....	6	.....	5¾	.....	4	.....
July 28	1½	.....	6	.....	4½	.....	3	.....
July 29	4½	.....	6	.....	5¾	.....	2½	.....
July 30	1½	.....	8	.....	4	.....	2½	.....
July 30	5	.....	6	.....	5¾	.....	4	.....
July 30	2	.....	6	.....	4½	.....	3	.....
Total milk	68	.....	96	.....	101½	.....	71	.....
Daily average	6.8	4.24	9.6	8.8	10.12	3.68	7.10	8.0

^a Beginning July 26, testing for butter fat was discontinued, owing to breakdown of Babcock tester.

Summary of detailed record of milk yields covering thirty days' trial of the Hegelund or Danish method of milking at Kamehameha School dairy, July 1-30, 1904.

COW NO. 4—GRADE HOLSTEIN, 5 YEARS OLD, SECOND CALF, THIRD QUARTER LACTATION PERIOD.

Milking periods.	Regular milking.				After milking.			
	Amount of milk.	Weight of milk.	Per-centage of fat.	Yield of fat.	Weight of milk.		Per-centage of fat.	Yield of fat.
	<i>Quarts.</i>	<i>Pounds.</i>	<i>Percent.</i>	<i>Pounds.</i>	<i>Ounces.</i>	<i>Pounds.</i>	<i>Per cent</i>	<i>Pounds.</i>
Period I, July 1-10	76¾	165.01	4.16	6.86	126½	8.50	8.80	0.747
Period II, July 11-20	76	163.40	4.49	7.33	93½	6.28	8.09	.507
Period III, July 21-30	68	146.20	4.24	6.19	96	6.45	8.80	.567
Entire time, July 1-30:								
Total yields	220¾	474.61	.....	20.38	.....	21.23	.....	1.821
Average (approximate) ..			4.29				8.56	

COW NO. 12—GRADE SHORTHORN, 7 YEARS OLD, FOURTH CALF, FIRST QUARTER LACTATION PERIOD.

Period I, July 1-10	99½	213.92	3.56	7.62	88	5.91	7.17	0.42
Period II, July 11-20	106¾	229.51	3.50	8.03	100½	6.75	8.30	.56
Period III, July 21-30	101½	217.67	3.68	8.01	71	4.77	8.00	.38
Entire time, July 1-30:								
Total yields	307½	661.12	.....	23.66	.....	17.43	.....	1.36
Average (approximate) .....	.....	.....	3.58	.....	.....	.....	7.82	.....

Original yields recorded in quarts and ounces, little or no milk being measured by weight in Hawaii. However, the original measurement has been converted into pounds, to conform with the more modern practice of weighing, 2.15 pounds being allowed per quart.

DISCUSSION OF RESULTS.

From the above data we ascertain that the average daily production of milk from the two cows, covering the thirty days' trial, was increased by 1.21 per cent wholly as a result of the use of the Hegelund method, the average daily yield from the regular milkings being 18.92 pounds and from the after milkings 0.64 pound daily. This is an apparently insignificant amount when taken by itself, but when it is remembered that this small increase of milk represents a 7 per cent increase in butter fat, the average daily yield of fat from the regular milking being 0.730 pound against 0.053 pound from after milkings, it will be seen that the matter is worthy of consideration. It is only necessary to apply these percentages to the yearly production of even a small dairy herd to gain some idea of the substantial additional income that would result to the dairy industry of Hawaii were this system universally practiced.

Assuming that the above figures represent average results obtainable in the school dairy, where there has been an average of ten cows milking throughout the year, it is safe to estimate that the increase in the total yield of milk would be 2,236 pounds, or 1,038 quarts, per annum, which is the average yield for dairy cows in Hawaii (probably a high estimate).

If sold at 10 cents per quart (the average price obtained) these 1,038 quarts from after milkings would give \$103.80 additional income, without additional expense other than the slight extra labor required for the manipulation; or, in other words, it might be said the general adoption of this method would raise the product of every ten cows to that of eleven cows, without extra cost.

Thus far we have only considered this increase as normal milk, while as a matter of record the milk obtained in the after milkings by the Hegelund method contained an average of 8.19 per cent butter fat, more than twice as much as the milk from regular milkings, and, therefore, from the butter-maker's standpoint, such milk would have double the value of ordinary milk.

To even more strikingly illustrate the possible value of the application of this method of milking to the dairies supplying milk to Honolulu alone, the following figures are submitted: The estimated number of dairy cows tributary to Honolulu is 1,500. Assuming two-thirds or 1,000 of these to produce milk three hundred days in the year, an increase of 0.64 pound in the daily production of milk would mean a gain of 89,302 quarts per annum, which at 6 cents per quart (the amount paid by the Honolulu Dairyman's Association) would add \$5,358 to the revenues of Honolulu dairymen annually, without further cost than the slight extra labor necessary to carry the Hegelund method into effect. But since, as has already been stated, such after milk contains 8.19 per cent of fat, we may assume the 89,302 quarts of such milk to yield 15,724 pounds butter fat, which at 40 cents per pound would yield \$6,289.

CONCLUSIONS AND RECOMMENDATIONS.

Although the experiment was limited to a thirty days' trial with only two cows, the circumstances under which it was conducted are such as to justify us in concluding that—

(1) After milking by the Hegelund or manipulation method is entirely practical, either on a large or small scale.

(2) Such practice would add at least \$10 per annum to the product of each average dairy cow, or every ten cows would yield the average product of eleven cows without additional expense other than the slight cost of extra labor.

(3) The above is a direct gain convertible into cash twice every twenty-four hours, while on the other hand the favorable after effects of exhaustive milking in developing and maintaining a larger and longer flow of milk can hardly be estimated.

(4) The increased richness of the after milk shows plainly how the quality of the general product of any dairy may be improved by this simple method. Probably much of the poor milk sold in the Honolulu market is traceable to a lack of thoroughness in milking, and to the more or less prevalent practice of allowing the calves to do the after milking, rather than to water added. The practice observed even in good dairies of allowing a hungry calf to do the stripping in order to prevent the cows from getting caked udders, or at least to prevent them drying off too soon, it is needless to say is good for fattening calves but profitless to the owner.

The Hegelund method of udder manipulations is easily learned by any intelligent milker who is interested in his work (see illustrations and description, pages 13-15), but since such help (in the writer's experience, at least) is difficult to find in Hawaii, it would be advisable for the owner, or man in charge, to assume the responsibility of after milking the whole herd rather than expect the regular milkers to apply the manipulations to their respective cows. Such a course would lead to greater expertness, uniformity, and thoroughness, which are important principles in the method.

A month's persistent practice should enable the operator to after milk from twenty to thirty cows per hour. The time so expended would prove by far the most profitable in the dairy, both in direct and indirect results.

The practice of this method as suggested would permit of an accurate check on the milkers, especially in large dairies.

It is believed that only minimum results are recorded in our experiment. Other investigators have included more or less strippings in the after milking, much of which is left by careless or ignorant ordinary milkers. In Scandinavia, where the manipulation method originated, the claim is generally made that the method will bring a regular

increase in the milk yield amounting to three-fourths to 1 liter (1.7 to 2.4 pounds) per head per day. If this is true then such large after yields mean one or the other of two things—either the first or regular milking is carelessly done, or else the system has been more highly perfected there than here. The fact probably is that the reports refer to maximum results, which are misleading.

The investigations of Prof. F. W. Woll at the Wisconsin Experiment Station^a covered a period of some four months, during which time 142 different cows were under experiment. The largest amount of milk per day obtained in the after milk from one cow was 5.5 pounds and of fat 0.64 pound, the smallest amount being 0.20 and 0.02 pound of milk and fat, respectively.

The summary for 142 cows further shows that about a quarter of the cows gave less than one-half pound of after milk, about one-third gave between one-half and 1 pound, and nearly another third gave between 1 and 2 pounds. Ten per cent of the cows gave more than 2 pounds (almost 1 quart) of milk per day in the after milking. The average amount of after milk for the 142 cows was 1.08 pounds per head per day. The average butter fat for all the cows was one-tenth of a pound per head per day.

Professor Woll concludes that: "The daily production of milk from our dairy cows can generally be increased by combined clean milking and manipulation of the udder by at least 1 pound per head, and that of butter fat by one-tenth of a pound. For a lactation period of 300 days this is equivalent to an increase of 30 pounds of butter fat, or 35 pounds of butter per cow per year." Estimating Wisconsin to have about a million milch cows, increasing their yields to the maximum would add 30,000,000 pounds of butter fat to the annual production, worth not less than \$6,000,000 at 20 cents a pound (a low valuation according to the Elgin market).

It is urged that dairymen reading this bulletin test the method herein described.

DESCRIPTION OF THE HEGELUND METHOD OF MILKING.

[From Wisconsin Station Bulletin 96.]

The milking is done with dry hands and with the whole hand. After the milk flows readily the milking is proceeded with as rapidly as possible and without interruption until full streams of milk are no longer obtained. At this point the milker begins with the manipulations of the udder, which are three in number, and may be described as follows:

First manipulation.—The right quarters of the udder are pressed against each other (if the udder is very large, only one quarter at a time is taken), with the left hand on

^a Wisconsin Sta. Bul. 96.

the hind quarter and the right hand in front of the fore quarter, the thumbs being placed on the outside of the udder and the four fingers in the division between the two halves of the udder. The hands are now pressed toward each other and at the same time lifted toward the body of the cow. This pressing and lifting is repeated three times. The milk collected in the milk cistern is then milked out, and the manipulation is repeated until no more milk is obtained in this way; then the left quarters are treated in the same manner. (See figs. 1 and 2.)

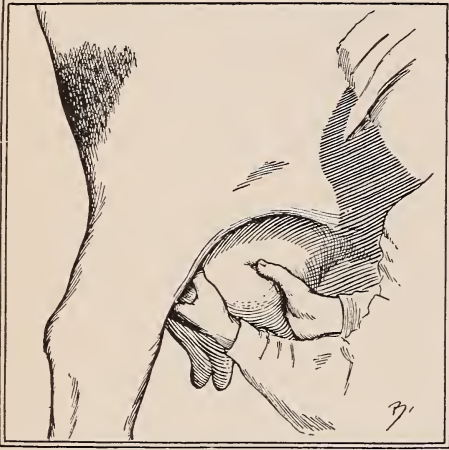


FIG. 1.—First manipulation of udder, right quarters.



FIG. 2.—First manipulation, left quarters.

Second manipulation.—The glands are pressed together from the side. The fore quarters are milked each by itself by placing one hand, with fingers spread, on the outside of the quarter and the other hand in the division between the right and left fore quarters; the hands are pressed against each other and the teat then milked. When no more milk is obtained by this manipulation, the hind quarters are milked by placing a hand on the outside of each quarter, likewise with fingers spread and turned upward, but with the thumb just in front of the hind quarter. The hands are lifted and grasp into the gland from behind and from the side, after which they are lowered to draw the milk. The manipulation is repeated until no more milk is obtained. (See figs. 3 and 4.)



FIG. 3.—Second manipulation, right fore quarter.



FIG. 4.—Second manipulation, hind quarters.

Third manipulation.—The fore teats are grasped with partly closed hands lifted with a push toward the body of the cow, both at the same time, by which method

the glands are pressed between the hands and the body; the milk is drawn after each three pushes. When the fore teats are emptied, the hind teats are milked in the same manner. (See fig. 5.)

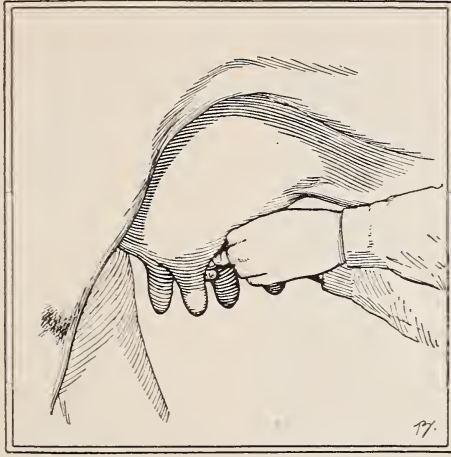


FIG. 5.—Third manipulation.

